DEPARTMENT OF ECOLOGY
State of Washington

Technical Support Document

for

The Asphalt Plant (Portable and Stationary) General Order

October 29, 2010

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

The Washington State Department of Ecology's (Ecology) Air Quality Program has determined that portable and stationary asphalt plants are candidates for General Orders of Approval as allowed by Chapter 173-400-560 Washington Administrative Code (WAC). All pollutants have been shown to be in compliance with National Ambient Air Quality Standards (NAAQS), Acceptable Source Impact Levels (ASILs), and below Title V major source thresholds of 100 tons per year (tpy) of criteria pollutants, 10 tons of any one Hazardous Air Pollutant (HAP), or 25 tons of combined HAPs. The following Technical Support Document (TSD) is the basis for that decision.

2. TYPES OF ASPHALT PLANT

2.1. Hot Mix Asphalt

Asphalt is made up of a combination of well-graded, high-quality aggregate that has been heated and uniformly mixed together before it is coated with a measured quantity of asphaltic cement. A hot mix asphalt plant can either be a permanent, skid mounted, or portable plant. They are designed to heat, mix, and combine the aggregate and asphalt in the proper proportions to give the desired asphalt paving mix. After it is mixed, the asphalt is transported to the paving site and spread as a loosely compacted layer. While it is still hot, the material is compacted and densified by heavy rollers to produce a smooth, well-compacted surface for roadways, parking lots, racetracks, liners for reservoirs, landfills, and other containment areas. One unique aspect of hot mix asphalt is that it can be recycled back into new hot mix asphalt material called Recycled Asphalt Pavement (RAP).

The process of producing hot mix asphalt includes drying and heating the aggregates, which assists the asphaltic coating to stick to the aggregate. Hot mix asphalt plants can be classified into three main categories: batch mix, continuous mix (mix outside drum), and drum mix. This analysis is limited to drum mix plants.

2.2. Drum Mix Plants

Drum mix plants dry the aggregate at the same time the liquid asphaltic cement is added into the drum mixer. Additionally, the aggregate must be screened and proportioned prior to entry into the mixing drum. The asphalt is then transferred to a storage silo awaiting load-out into a haul truck. There are two typical designs of drum mix asphalt plants: parallel flow and counter flow. A parallel flow drum is where the aggregate is introduced at the burner end. As the drum rotates, the aggregate and emissions travel in parallel towards the other end of the drum. One advantage of a parallel flow drum mix plant is that the mixture has additional time to collect fine particles (dust) into the mix and therefore has lower emissions of particulate as compared to a batch mix asphalt plant.

If the aggregate were flowing in the opposite direction of the exhaust gases, the drum mix plant would be considered a counter flow plant. Counter flow plants have lower volatile organic compounds (VOC) than parallel flow plants because the mixing zone is located behind the burner flame zone and the material is not in direct contact with the hot exhaust gases.

2.3. Drum Mix Asphalt Plant Process Unit

The following sections list the process units associated with drum mix asphalt plants.

2.3.1. Asphalt Cement Storage Tank and Heater

The asphalt cement storage tank preheats the asphaltic cement before transferring it to the mixer. Emissions are considered fugitive from the storage tank but emissions from the heater are ducted to a fabric filter.

2.3.2. Rotary Dryer and Heater

The rotary dryer and heater preheat the aggregate prior to transferring it to the elevator. This is an enclosed unit and once the aggregate enters the dryer all emissions are routed through a primary collector (cyclone) before they are sent to the fabric filter. This unit uses natural gas, Liquid Petroleum Gas (LPG), or on-road specification diesel fuel as fuel for the dryer and heater. There are some fugitive emissions at the entrance to the dryer, but they are discussed under the fugitive emissions section below.

2.3.3. Fabric Filter

The fabric filter (baghouse) collects emissions from the dryer via the cyclone, the elevator, the hot screens, and the mixer.

2.3.4. Hot Mix Asphalt Storage Silo

The hot mix asphalt storage silo receives hot mixed asphalt from the mixer and stores it temporarily before loading it into trucks. Emissions from the storage silo are fugitive at the entrance to the silo and the load-out of the trucks.

2.3.5. Drum Mixer

The drum mixer can be a source of ducted and fugitive emissions.

2.3.6. Fugitive Emissions

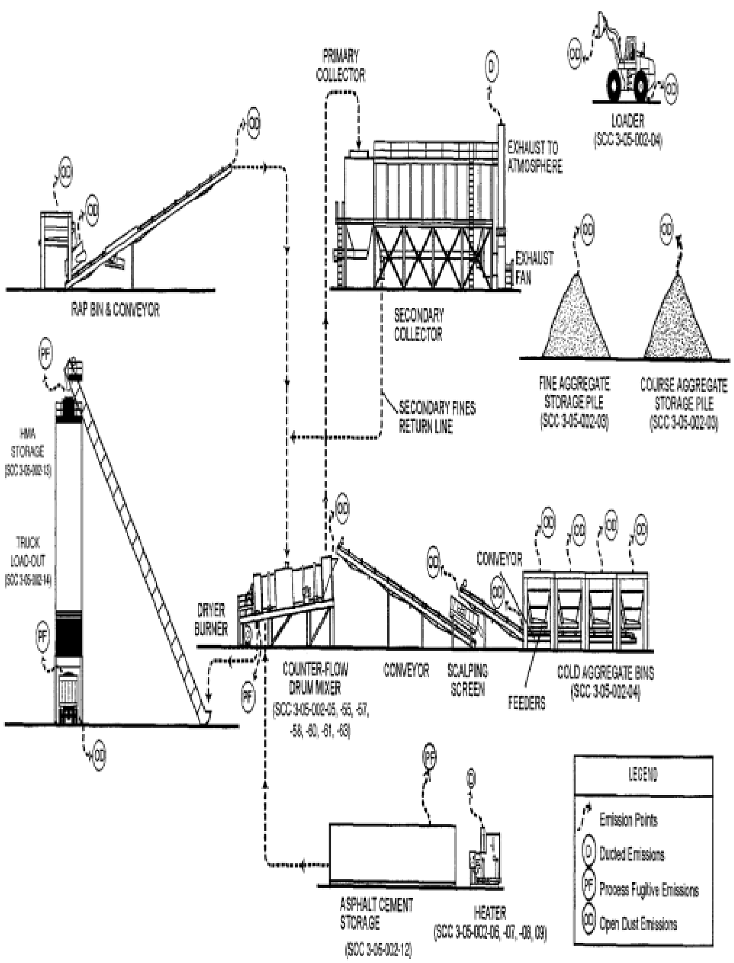
There are multiple fugitive emission sources at a batch mix plant. They include but are not limited to aggregate storage piles and bins, conveyor belts, hoppers at the ends of the conveyor belts, the hot asphalt cement storage tank, truck load-out, truck traffic on haul roads, the hot mix asphalt mixer, the hot mix asphalt storage tank, the RAP bin and conveyor, and yard emissions.

2.3.7. Generators

All hot mix asphalt plants need electricity. Stationary plants are usually connected to line power. Portable plants are typically powered by two diesel-fueled electric generators. It is estimated that they need approximately 1,200 kWe of electrical power. The emissions from these generators are point sources. This General Order does not address emissions associated with power generation. An asphalt plant must address this issue separately by using line power, portable electric generators, or non-road engines.

2.4. Other

The following is a drawing of a typical batch asphalt plant:



2.5. Emissions From Each Emission Point and its Associated Emission Factors

2.5.1. Criteria Pollutant Emission Factors

Twenty different source tests were evaluated when selecting the proposed emission factor. Enforcement staff wanted emission factors to be presented as pounds per hour but the preparer believes that using pounds per ton of hot mix asphalt (lb/ton HMA) produced is a better way to regulate asphalt emissions. The data were sorted and presented as the mean, the median, the standard deviation plus one sigma, the 75 percentile, the high value in the data set, and the low value in the data set as shown in Table 1.

Table 1

	Total Particulate Corrected to 15% O_2 (lb/ton HMA)	Total NO_X (lb/ton HMA)	SO_2 (lb/ton HMA)	CO (lb/ton HMA)	VOC (lb/ton HMA)
Mean (average)	0.009	0.030	0.010	0.043	0.024
Median (average)	0.010	0.028	0.006	0.025	0.020
Standard Deviation	0.005749003	0.013794848	0.012864414	0.041266605	0.01582376
75th Percentile	0.011	0.034	0.015	0.042	0.035
One Sigma	0.015	0.043	0.023	0.084	0.040
High Value in Range	0.023	0.060	0.020	0.130	0.052
Low Value in Range	0.001	0.010	0.0001	0.010	0.002

2.6. Applicable State Laws and Rules

The authority to issue air permits to stationary sources is contained in the Washington State Clean Air Act, specifically Revised Code of Washington (RCW) 70.94.152. The implementation regulations include Chapter 173-400 WAC and Chapter 173-460 WAC.

2.6.1. Chapter 173-400 WAC

The General Regulations for Air Pollution Sources include some general requirements.
They include:

- A requirement to not discharge particulate in excess of 0.1 gr/dscf from combustion units.
- A requirement to not cause or allow emissions in excess of 20 percent opacity.
- A requirement for a source to obtain a Notice of Construction (NOC) Order of Approval.

2.6.2. Chapter 173-460 WAC

The Controls for New Sources of Toxic Air Pollutants sets forth a process to evaluate emissions of TAPs. Most notably is a requirement to perform a site-specific Health Impact Assessment (HIA) should emissions of any toxic air pollutant (TAP) exceed a trigger level referred to as an ASIL.

2.7. Applicable Federal Rules

2.7.1. 40 CFR 60.91 Also Known as Subpart I

The Standards of Performance for Hot Mix Asphalt Facilities includes several requirements. They include:

- A requirement to performance test in accordance with 40 Code of Federal Regulations (CFR) 60.8.
- A requirement to not discharge particulate in excess of 0.04 gr/dscf (assume this is TSP).
- A requirement to not discharge emissions in excess of 20 percent opacity.
- A requirement to use 40 CFR 60 Appendix A, Method 5 for particulate.
- A requirement to use 40 CFR 60 Appendix A, Method 9 for opacity.

3. ESTIMATE OF PROJECT EMISSIONS

3.1. Emissions of Criteria Pollutants

Based upon the derived emission factors, the sources subject to permitting under this general order are expected to have emissions less than or equal to those shown in Table 2.

Table 2. Criteria Pollutants

Source	Units	$PM_{2.5}$	PM_{10}	TSP	NO_X	SO_2	CO	VOC
Baghouse	tpy	1.80	1.80	1.80	5.68	2.49	7.01	5.76
Fugitive Haul Road	tpy	0.04	0.36	1.45	0	0	0	0
Total	tpy	1.84	2.16	3.25	5.68	2.49	7.01	5.76
	max lb/hr	6.13	7.20	10.85	18.95	8.29	23.36	19.20

3.2. Emissions of TAPs

Table 3

TAP	Emissions (lb/yr)
Acetaldehyde	64
Benzene	78
Ethylbenzene	48
Formaldehyde	620
Toluene	580
Benz[a]anthracene	0.042
Benzo[a]pyrene	0.002
Benzo[b]fluoranthene	0.02
Benzo[k]fluoranthene	0.008
Chrysene	0.036
Dibenz[a,h]anthracene	0.00002
Indeno[1,2,3-cd]pyrene	0.001
Naphthalene	130
Carbon monoxide (tpy)	7.01
Sulfur dioxide (tpy)	2.49
Arsenic	0.168
Cadmium	0.123
Cobalt	0.0078
Copper	0.93
Chrome 6	0.135
Lead	4.5
Manganese	2.31
Mercury	0.78
Selenium	0.105

These estimates are based upon the following assumptions:

- Hourly production is limited to 500 tons of HMA.
- Daily production is limited to 6,000 tons of HMA.
- Annual production is limited to 300,000 tons of HMA.
- The majority of fugitive emissions come from the haul trucks entering and leaving the site. All other fugitive emissions of particulate are considered negligible.
- The fugitive dust control plan will be 70 percent effective in reducing fugitive emissions from trucks entering and leaving the site.

4. DETERMINATION OF BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

4.1. BACT for NO_X

BACT for nitrogen oxides (NO_X) was calculated by adding the 75th percentile of the 20 source test reports reviewed, plus 10 percent or 0.038 lb/ton HMA. After further consideration, this number was so far below the Synthetic Minor (SM) 80 limit, BACT switched from a numerical limit to Proper Operation and no limit was inserted into the permit.

4.2. BACT for SO_2

BACT for sulfur oxides (SO_2) was calculated by adding the 75th percentile of the 20 source test reports reviewed, plus 10 percent or 0.017 lb/ton HMA, and the use of low sulfur fuels. After further consideration, this number was so far below the SM 80 limit, BACT switched from a numerical limit to Proper Operation and no limit was inserted into the permit.

4.3. BACT for CO

BACT for carbon monoxide (CO) was calculated by adding the 75th percentile of the 20 source test reports reviewed, plus 10 percent or 0.047 lb/ton HMA. After further consideration, this number was so far below the SM 80 limit, BACT switched from a numerical limit to Proper Operation and no limit was inserted into the permit.

4.4. BACT for $PM_{2.5}$

BACT for particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$) was calculated by adding the 75th percentile of the 20 source test reports reviewed, plus 10 percent or 0.012 lb/ton HMA.

4.5. BACT for PM_{10} Determined to be Equal to $PM_{2.5}$

BACT for particulate matter smaller than 10 microns in diameter (PM_{10}) has been determined to be the same as $PM_{2.5}$.

4.6. BACT for TSP

BACT for total suspended particulate (TSP) has been determined to be the same as $PM_{2.5}$.

4.7. BACT for Toxic Air Pollutants

BACT for TAPs has been determined to be proper operation with emissions less than the ASILs.

Additional requirements are:

- Hourly production is limited to 500 tons of HMA.
- Daily production of HMA is limited to 6,000 tons of HMA.
- Annual production is limited to 300,000 tons of HMA.
- A fabric filter (baghouse) shall be used to control particulate matter emissions from the drum-mix dryer.
- The asphalt drum mixer must be 150 MMBtu/hr heat input or less.
- All fuel used to fire the drum mix dryer shall be natural gas, liquified petroleum gas (LPG), or diesel fuel with a sulfur content of 0.0015 percent or less by weight.
- The minimum distance from the property boundary to any emission unit, including the drum mix dryer, storage silo, baghouse exhaust, asphalt cement oil storage tanks, and load-out operations, shall be 150 feet. Note: A value of 121 feet was used in the modeling for this evaluation. Staff recommended that that distance be increased to 150 feet. One hundred fifty feet is a distance that is normally seen at asphalt plants.
- For Stationary Asphalt Plants, a scavenging system scavenger fan and ducting to collect VOCs and asphalt fumes from the asphalt storage silo and slate conveyor shall be routed to the burner to be consumed.
- An interlock or other fail-safe device shall prevent the drum mix dryer from operating if either the baghouse or the scavenging fan is not operating.
- At no time may a plant exceed its maximum production rating of the installed equipment.
- Asphalt cement heaters must have a minimum of one self-regulating automatic overheating disconnects.
- The percent of RAP used in the asphalt cement mix under this approval is limited to the percent of RAP used during source testing.
- The exhaust stack discharge point for the baghouse exhaust shall be at least 23 feet above ground level.
- Opacity shall be limited to 10 percent.

4.8. Summary of BACT

Table 4

Pollutant	Limits	
PM, $PM_{2.5}$, and PM_{10}	0.020 gr/dscf @ 15% Oxygen < 80 tpy	0.012 lb/ton HMA
NO_X	< 80 tpy	-
CO	< 80 tpy	-
SO_2	< 80 tpy	-
VOC	< 80 tpy	-
TAPs	< ASIL	-
Hazardous Air Pollutants (HAP)	< 10 tons of any HAP	-
HAP	< 25 of any combination of HAPs	-

5. AMBIENT AIR IMPACT ANALYSIS

Each new or modified source of air pollution must undergo an ambient impact analysis to ensure compliance with the NAAQS and a toxics screening to ensure emissions are below the appropriate ASIL.

5.1. Model Used

The emissions were modeled using Screen 3, version 96043 on July 19, 2010. A cracker box was developed to represent a standard asphalt plant. The height of the stack, the dimensions of the baghouse, the flow rate, and temperature was developed from existing asphalt plants in Washington.

The following table is the model inputs:

Table 5

Model Input	Value	Units
Source Type	point	Unit less
Emission Rate	1	g/sec
Stack Height	7	Meters
Stack Diameter	1.22	Meters
Exit Velocity	17.65	Meters/sec
Gas Temperature	402	°K
Ambient Temperature	293	°K
Receptor Height	1.4	Meters
Urban/Rural	R	Unit less
Downwash	Yes	Unit less
Building Height	7.6	Meters
Min. Dimension	4.6	Meters
Max. Dimension	4.6	Meters

Results from the modeling showed that the maximum impact occurs 37 meters (122 feet) from the source.

5.2. AAQS Analysis

All pollutants were modeled and found to be below the NAAQS as shown in Table 6.

Table 6

NO_X		CO		SO_2		PM		PM_{10}		$PM_{2.5}$	
1-hr	Annual	1-hr	8-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr
188.7 (μg/m_3)	100 (μg/m_3)	40,000 (μg/m_3)	10,000 (μg/m_3)	30 (μg/m_3)	140 (μg/m_3)	60 (μg/m_3)	150 (μg/m_3)	50 (μg/m_3)	150 (μg/m_3)	15 (μg/m_3)	35 (μg/m_3)
84	4	690	5	2	49	2	64	1	43	1	0.15

5.3. ASIL Analysis

Twenty-four TAPs were evaluated as part of this asphalt plant General Order. Additionally, out of the 24 pollutants modeled, 16 had emissions lower than their Small Quantity Emission Rates (SQER). The remaining eight were modeled against their ASILs.

Table 7

CAS#	Pollutant	Averaging Period	SQER	Pounds per Averaging Period
75-07-0	Acetaldehyde	annual	71	64
71-43-2	Benzene	annual	6.62	78
100-41-4	Ethylbenzene	annual	76.8	48
50-00-0	Formaldehyde	annual	32	620
108-88-3	Toluene	24-hr	657	580
56-55-3	Benz[a]anthracene	annual	1.74	0.04
50-32-8	Benzo[a]pyrene	annual	0.174	0.002
205-99-2	Benzo[b]fluoranthene	annual	1.74	0.02
207-08-9	Benzo[k]fluoranthene	annual	1.74	0.008
218-01-9	Chrysene	annual	17.4	0.04
53-70-3	Dibenz[a,h]anthracene	annual	0.16	0
193-39-5	Indeno[1,2,3-cd]pyrene	annual	1.74	0.001
91-20-3	Naphthalene	annual	5.64	130
630-08-0	Carbon monoxide	1-hr	50.4	0.134
7446-09-05	Sulfur dioxide	annual	1.45	2,200
-	Arsenic	annual	0.0581	0.168
-	Cadmium	annual	0.0457	0.123
7440-48-4	Cobalt	24-hr	0.013	0.000156
-	Copper	1-hr	0.219	0.0000134
18540-29-9	Chrome 6	annual	0.00128	0.135
-	Lead	annual	16	4.5
-	Manganese	24-hr	0.005	0.0462
7439-97-6	Mercury	24-hr	0.012	0.0156
-	Selenium	24-hr	2.63	0.00120

All pollutants were found to be below the ASILs as shown in Table 8.

Table 8

Pollutant	Averaging Period	ASIL ($\mu g/m_3$)	Concentration ($\mu g/m_3$)
Benzene	annual	0.0345	0.0041
Formaldehyde	annual	0.1670	0.050
Naphthalene	annual	0.0294	0.0083
Sulfur dioxide	annual	660	0.1401
Arsenic	annual	0.000303	0.00000713
Cadmium	annual	0.000238	0.00000522
Hexavalent chromium	annual	0.00000667	0.00000573
Manganese	24-hr	0.04	0.000392
Mercury	24-hr	0.09	0.000132

6. CONCLUSION

Ecology’s Air Quality Program finds that this evaluation meets all the requirements of NSR. Additional background material can be found in an Excel spreadsheet titled “7-22-10 Asphalt Batch Plant General Order Material.”

For more information, please contact:

Richard B. Hibbard, P.E.
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
Phone: (360) 407-6896
Fax: (360) 407-7534
richard.hibbard@ecy.wa.gov

7. LIST OF ABBREVIATIONS AND ACRONYMS

ASIL	Acceptable Source Impact Level
BACT	Best Available Control Technology
CFR	Code of Federal Regulations
CO	Carbon monoxide
Ecology	Washington State Department of Ecology
g	Grams
HAP	Hazardous Air Pollutant
HIA	Health Impacts Assessment
°K	Degrees Kelvin
kWe	Kilowatts of Electricity
lb/ton HMA	Pounds per ton of hot mix asphalt
LPG	Liquid Petroleum Gas
NAAQS	National Ambient Air Quality Standard
NOC	Notice of Construction
NO_X	Nitrogen oxides
$PM_{2.5}$	Particulate matter smaller than 2.5 microns in diameter
PM_{10}	Particulate matter smaller than 10 microns in diameter
RAP	Recycled Asphalt Pavement
RCW	Revised Code of Washington
sec	Second
SM 80	80% of Title 5 Thresholds, Synthetic Minor 80
SO_X	Sulfur oxides
SQER	Small Quantity Emission Rate
TAP	Toxic Air Pollutant
tpy	Tons per year
TSD	Technical Support Document
TSP	Total Suspended Particulate (This is equivalent to PM.)
WAC	Washington Administrative Code